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Total (1)	8	-



US005695349A

**United States Patent** [19]

Taguchi et al.

[11] Patent Number: **5,695,349**[45] Date of Patent: **Dec. 9, 1997****[54] LOCK MECHANISM OF A PAIR OF ELECTRICAL CONNECTORS**[75] Inventors: Naoto Taguchi; Kenichi Okamoto,  
both of Shizuoka, Japan

[73] Assignee: Yazaki Corporation, Tokyo, Japan

[21] Appl. No.: 558,180

[22] Filed: Nov. 15, 1995

**[30] Foreign Application Priority Data**

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[51] Int. Cl.<sup>6</sup> ..... H01R 13/62

[52] U.S. Cl. .... 439/157

[58] Field of Search ..... 439/157, 155,  
439/310, 372**[56] References Cited****U.S. PATENT DOCUMENTS**

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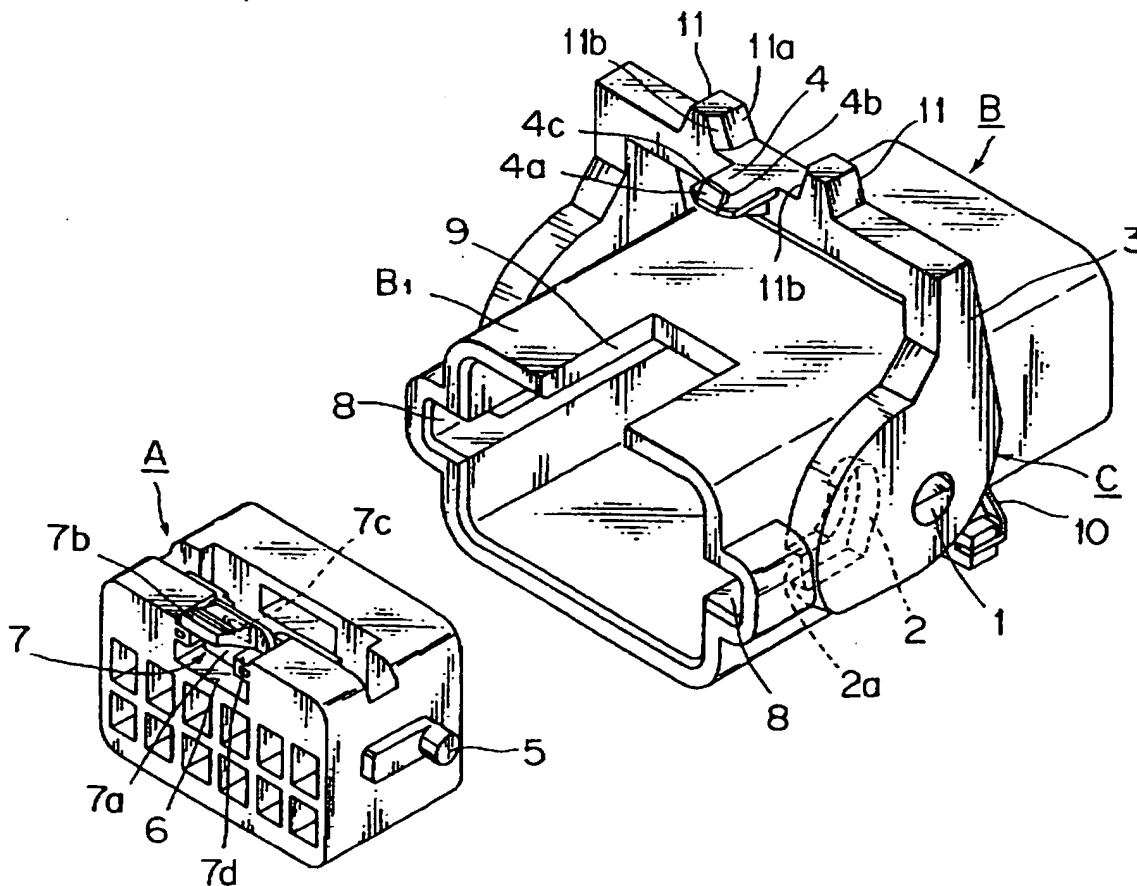
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*Primary Examiner*—P. Austin Bradley*Assistant Examiner*—Tho Dac Ta*Attorney, Agent, or Firm*—Armstrong, Westerman, Hattori,  
McLeland & Naughton**[57] ABSTRACT**

One of a pair of mating electrical connectors A, B has a cam groove 2 and a coupling lever C pivotally attached to the one connector. The coupling lever C has an operation portion 3 provided with a locking engagement portion 4 and a pair of lock-guiding portions 11 positioned at opposite sides of the locking engagement portion 4. The other one of the connectors has a driving pin 5 for advancing into the cam groove 2 and a lock portion 7. When the pair of connectors A, B engage with each other by operating the coupling lever C, the locking engagement portion 4 slidably engages the lock portion 7 so that the center line of the locking engagement portion 4 is urged toward the center line of the lock portion 7.

**8 Claims, 4 Drawing Sheets**

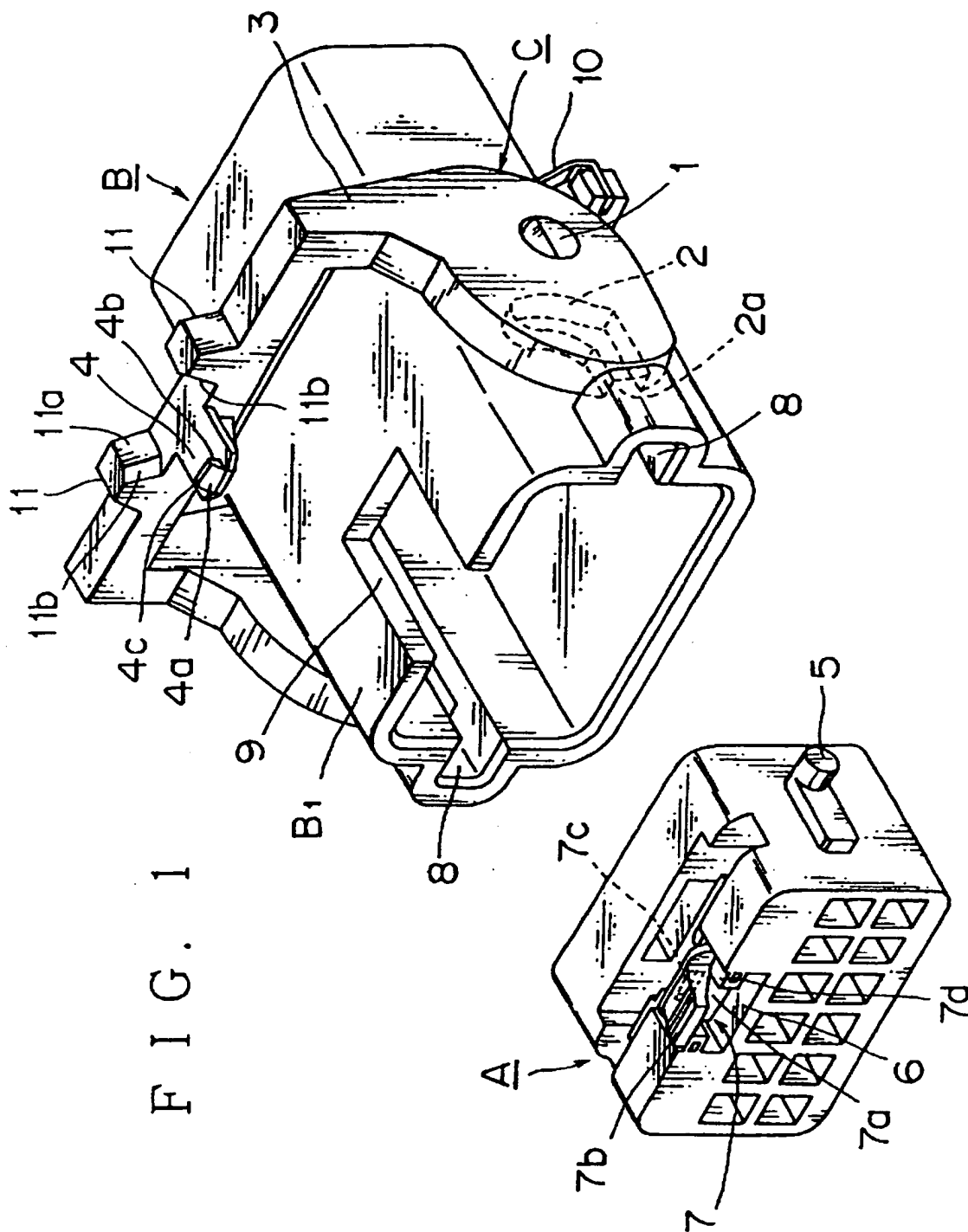


FIG. 2 A

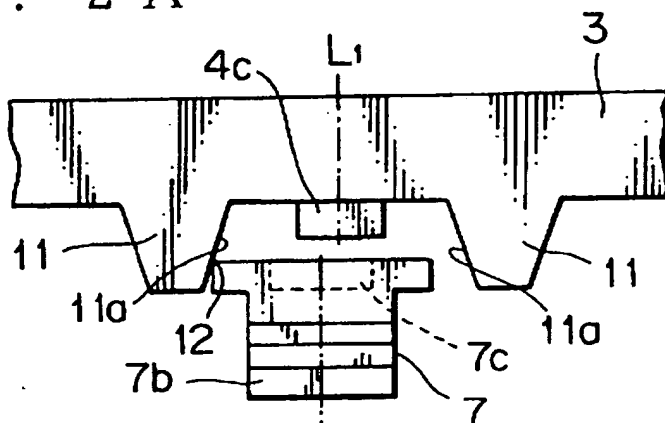


FIG. 2 B

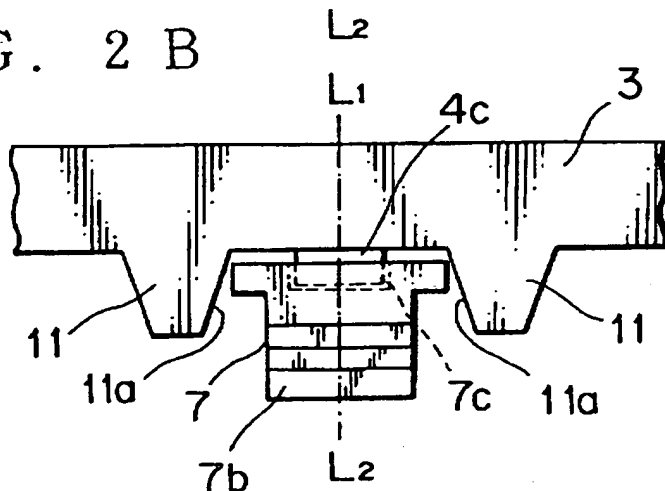


FIG. 6  
PRIOR ART

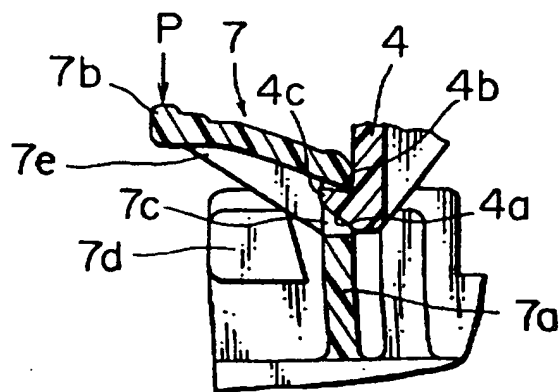


FIG. 7  
PRIOR ART

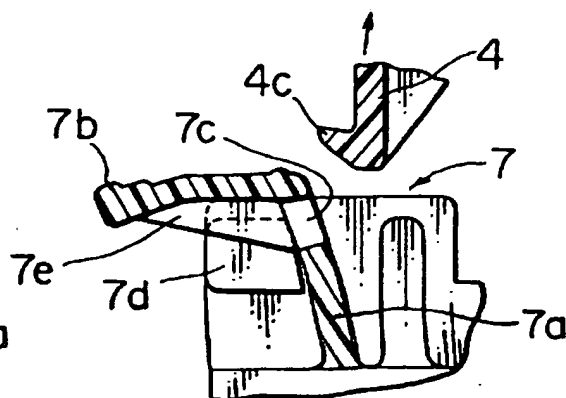


FIG. 3

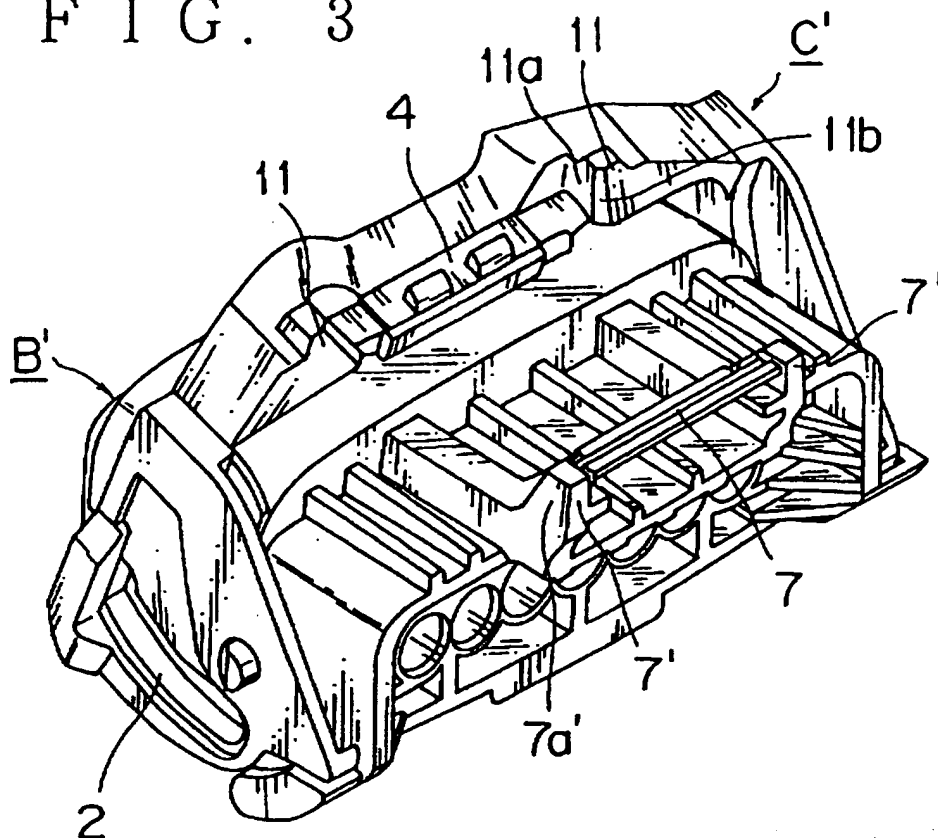


FIG. 4

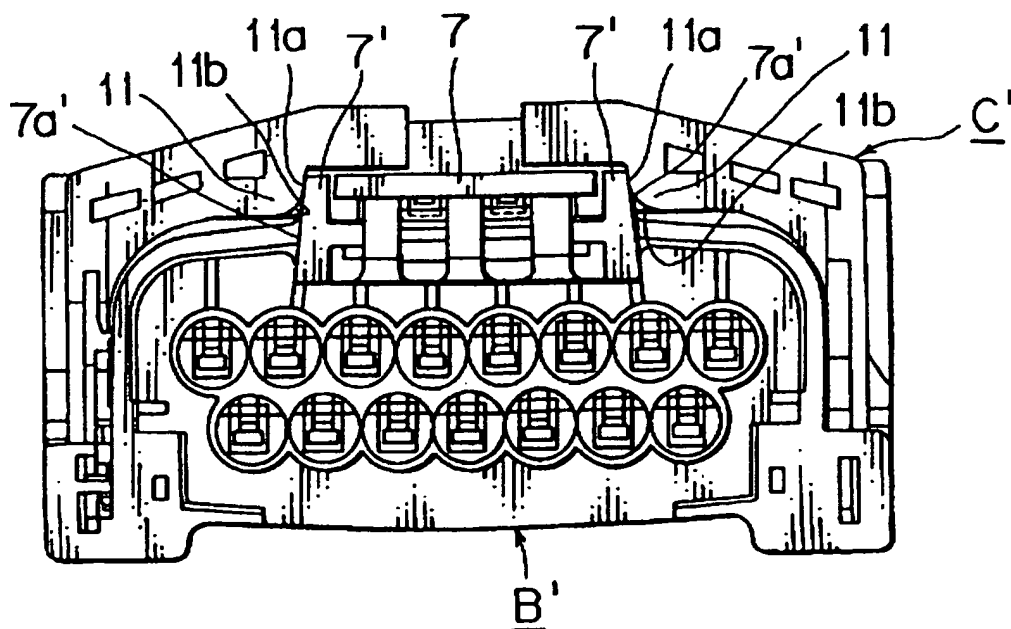
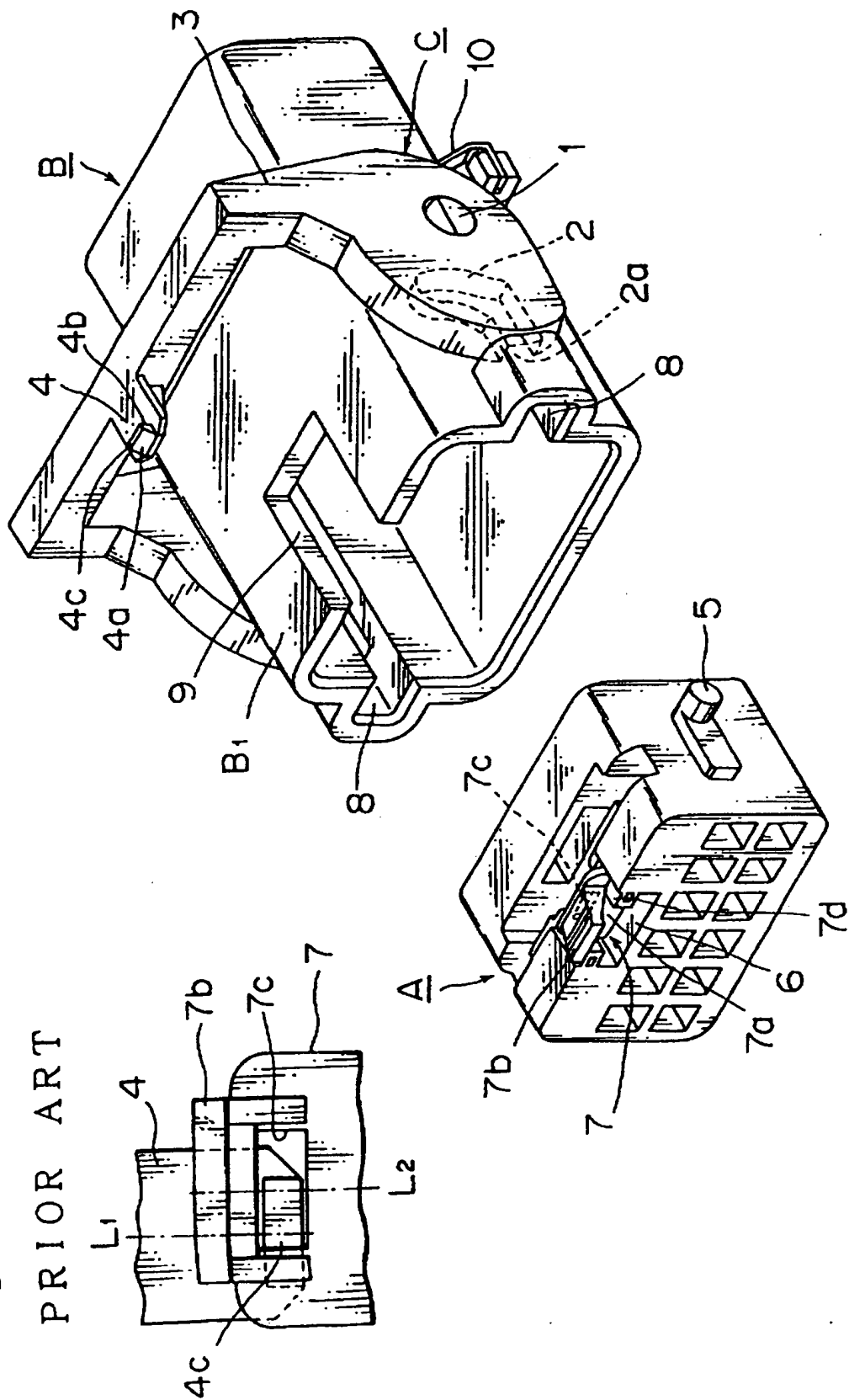


FIG. 5 PRIOR ART



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# LOCK MECHANISM OF A PAIR OF ELECTRICAL CONNECTORS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates to electrical connectors, and more particularly to a lock mechanism for a pair of mating electrical connectors having a coupling lever which requires only a low coupling and uncoupling force, for connecting wire harnesses with each other, or for connecting wire harnesses to electric equipment in automobiles.

### 2. Description of the Prior Art

Referring to FIG. 5, reference numeral A denotes a male connector made of synthetic resin; B denotes a female connector of the same kind; and C denotes a coupling lever pivotably engaged to a supporting shaft 1 attached to the female connector B. The coupling lever C has a cam guiding groove 2 and an operating portion 3 provided with a locking engagement portion 4 at the middle thereof. The locking engagement portion 4 includes a locking projection 4c having a tapered engagement guiding face 4a and an engagement face 4b.

On both side walls of the male connector A there is provided a driving pin 5 protruding from the connector and in a recess 6 of the front wall of the connector A there is provided a substantially L-shaped lock portion 7. In the recess 6, an upstanding flexible locking plate 7a has a lock releasing portion 7b at the upper end thereof extruding backwards with respect to the male connector A. The flexible locking plate 7a is provided with a locking hole 7c, and in the rear of the flexible locking plate 7a there is provided a stopper 7d for preventing an excessive deflection of the flexible locking plate 7a. Between the flexible locking plate 7a and the lock releasing portion 7b are provided a pair of reinforcing members 7e.

In the fore side of the female connector B there is provided a hood B1 for receiving the male connector A. In each inside wall of the hood B1 there is provided a pin-receiving guide grooves 8 receiving a driving pins 5. The pin-receiving guide groove 8 is aligned with, and the same in section size as, an inlet portion 2a of the cam groove 2 of the coupling lever C when the lever C is in the nonoperating position. In the upper wall of the hood B1 there is provided a cut-out portion 9 receiving the locking engagement portion 4. The coupling lever C keeps an upstanding position in the nonoperating state by a plate spring 10.

Accordingly, when the male connector A and the female connector B engage with each other, the driving pins 5 advance into the cam grooves 2 through the pin guide groove 8. In the state where the driving pins 5 have been received in the cam grooves 2, pivoting the coupling lever C by the operating portion 3 pulls the male connector A into the hood B1 of the female connector B. When the engagement has been completed, the locking engagement portion 4 engages with the lock portion 7 to keep the locking state. The male connector A and the female connector B have terminal-receiving slot cavities each of which face to a corresponding one in the other connector, and each terminal fitting (not shown) in the terminal-receiving slot cavities connects to a corresponding one in the engaged state of the connectors.

When the connectors completely engage with each other, a locking projection 4c on the locking engagement portion 4 abuts the flexible locking plate 7a of the lock portion 7 by way of a tapered guide surface 4a to enable the locking projection into the locking hole 7c as the flexible locking

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plate 7a is deflected backwardly. Then, a locking surface 4b engages with the locking hole 7c of the flexible locking plate 7a when the locking plate has returned to the upright position, as shown in FIG. 6.

In the locked condition of FIG. 6, by pushing the lock releasing portion 7b in the direction of an arrow head P, the flexible locking plate 7a is deflected backwardly so that the locking projection 4c is unlocked to be released from the locking hole 7c, as shown in FIG. 7.

In the above-mentioned structure, if the coupling lever C is pivoted by a manual force biased to one side of the operating portion 3, there may be a drawback that, due to the lateral inclination of the operating portion 3, the center line L1 of the locking engagement portion 4 will deviate from the center line L2 of the lock portion 7, as shown in FIG. 8, so that the locking projection 4c does not engage with the locking hole 7c.

## SUMMARY OF THE INVENTION

This invention is provided to eliminate the above-mentioned drawback. Therefore, even if there is a lateral inclination of the operating portion in the operation of the coupling lever, the center line of the locking engagement portion related to the coupling lever is forced to be in line with the center line of the lock portion related to the connector to enable a secure engagement.

For achieving the above-mentioned object, a first aspect of the invention includes one of a pair of electrical connectors engaging with each other having a cam groove and an coupling lever pivotably attached to the one connector, wherein the coupling-operating lever has an operation portion provided with a locking engagement portion and a pair of lock-guiding portions, each of which is positioned at the respective sides of the locking engagement portion; and

the other one of the connectors having a driving pin for advancing into the cam groove, and a lock portion.

When the pair of connectors engage with each other by operating the coupling lever, the locking engagement portion slidably abuts the lock guiding portions so that the center line of the locking engagement portion can move toward the center line of the lock portion.

Further, a second aspect of the invention includes one connector B' of a pair of electrical connectors, which engage with each other, having a cam groove 2 and a coupling lever C' pivotably attached to the one connector B', wherein the coupling operating lever C' has an operation portion 3 provided with a locking engagement portion 4 and a pair of lock guiding portions 11, 11 positioned at both sides of the locking engagement portion 4; and

the other one of the connectors has a driving pin 5 advancing into the cam groove 2, a lock portion 7, and lock protecting walls 7', 7' positioned at the respective sides of the lock portion 7.

When the pair of connectors engage with each other by operating the engagement lever C', the lock-guiding portion 11 slidably abuts the lock-protecting wall 7' so that the center line of the locking engagement portion 4 can move toward the center line of the lock portion 7.

Further, a third aspect of the invention includes one of a pair of electrical connectors A, B engaging with each other having a cam groove 2, a lock portion 7, and a coupling lever C pivotably attached to the one of connectors, wherein the coupling lever C has an operation portion 3 provided with a locking engagement portion 4 and a pair of lock guiding portions 11, 11 positioned one at each side of the locking engagement portion 4; and

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the other one of the connectors having pin 5 for advancing into the cam groove 2.

When the pair of connectors A, B engage with each other by operating the coupling lever C, the lock-guiding portion 11 slidably abuts to the lock portion 7 so that the center line of the locking engagement portion 4 can move toward the center line of the lock portion 7.

Further, a fourth aspect of the invention includes one connector B' of a pair of electrical connectors engaging with each other having a cam groove 2, a lock portion 7, lock protecting walls 7', 7' positioned one at each side of the lock portion 7, and a coupling lever C' pivotally attached to the one connector B', wherein the coupling lever C' has an operation portion 3 provided with a locking engagement portion 4 and a pair of lock-guiding portions 11, 11 positioned at both sides of the locking engagement portion 4; and

the other one of the connectors has a driving pin 5 for advancing into the cam groove 2.

When the pair of connectors engage with each other by operating the coupling lever C', the locking-guiding portion 11 slidably abuts the lock protecting portion 7' so that the center line of the locking engagement portion 4 can move toward the center line of the lock portion 7.

Accordingly, in the operations of the above-mentioned aspects of invention, the lock-guiding portion slidably abuts the lock portion or the lock protecting portion so as to correct the position of the coupling lever so that the center line of the locking engagement portion can move toward the center line of the lock portion.

As a result, this invention has an advantage that the locking engagement portion of the coupling lever securely engages with the lock portion of the connector.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing a pair of mating electrical connectors according to an embodiment of the present invention in their separated state;

FIG. 2A and FIG. 2B are enlarged views showing a movement of a lock guiding portions in the locking operation of the embodiment;

FIG. 3 is a perspective view showing a female connector according to another embodiment of the present invention before engagement operation thereof;

FIG. 4 is a front view showing primary parts of the embodiment in FIG. 3 in the lock engagement state;

FIG. 5 is a perspective view showing a pair of mating electrical connectors of the prior art in their separated state;

FIG. 6 is a sectional view showing primary parts of the prior art in FIG. 5 in the lock engagement state;

FIG. 7 is a sectional view showing primary parts of the prior art in FIG. 5 in the lock released state; and

FIG. 8 is a front view showing primary parts of the prior art in FIG. 5 in the incomplete lock engagement state.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 is an embodiment of this invention, which includes a male connector A, a female connector B, and a coupling lever C similar to the prior art shown in FIG. 5. The same reference symbols are accordingly given to the same portions as ones of the prior art.

Specifically in this invention, an operating portion 3 of the coupling lever C is provided with lock-guiding projecting portions 11, 11 in both sides of a locking engagement portion 4. In the sides of the pair of lock-guiding projecting portions

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11, 11, facing the locking engagement portion there are provided tapered lock-guiding faces 11a, 11a.

Further, the tapered lock-guiding faces 11a, 11a are provided each with a tapered abutting face 11b, 11b at the leading edges thereof in the pivoting direction of the coupling lever C when the connectors are coupled.

In the above-mentioned structure, when pivoting the coupling lever C forward to the female connector B in the coupling operation of the connectors A, B by a manual force biased to one side of the operating portion 3, the center line L1 of the locking engagement portion 4 may initially deviate from the center line L2 of the lock portion 7, as shown in FIG. 2A. However, one of the lock-guiding projecting portions 11 abuts a leading corner 12 of the lock portion 7 at a tapered lock guiding face 11a, which corrects the transverse position of the operating portion 3 toward the position that the center lines L1, L2 are in line with each other so that the locking projection 4c surely engages with the locking hole 7c, as shown in FIG. 2B.

In another embodiment, shown in FIG. 3, a female connector B' has a flexible lock portion 7 provided above a top wall of the female connector housing. On both sides of the flexible lock portion 7 there are provided upstanding, lock-protecting walls 7', 7' that each have an engagement guiding surface 7a' tapered from the bottom to the top of the wall 7', while a coupling lever C', pivotally attached to the connector B', has a locking engagement portion 4 and protruding, lock guiding portions 11 at both sides of the locking engagement portion 4. Further, the pair of lock-guiding portions 11, 11 are provided with tapered lock guiding faces 11a, 11a opposing each other. Moreover, at each leading end of the tapered lock guiding faces 11a, 11a there is provided a tapered abutting face 11b for guiding the engagement of the lever C.

A male connector, not illustrated, has a driving pin for advancing into a cam groove 2 formed in the coupling lever C' so that pivoting the coupling lever C' to the rear of the female connector B' causes the pair of male and female to engage with each other.

In the above-mentioned structure, when the coupling lever C' pivots toward the rear of the female connector B' so that the pair of connectors engage with each other, the locking engagement portion 4 and the lock portion 7 may possibly approach each other with their centers being mutually offset. Even in that case, one of the tapered lock-guiding faces 11a of the lock guiding portion 11 slidably engages to the tapered engagement guiding surface 7a' of the facing lock protecting walls 7' to correct the offset so that the locking engagement portion 4 can engage with the lock portion 7 (FIG. 4).

In the embodiment of FIGS. 3 and 4, the lock portion 7 and the lock-protecting walls 7', 7' may be provided on the male connector and the coupling lever C' having a structure that enables it to pivot toward the front part of the male connector in the coupling operation.

In the embodiment in FIGS. 1 and 2, the lock portion 7 may be provided in the rear of the female connector B and the coupling lever C having a structure that enables it to pivot toward the rear of the female connector B.

What is claimed is:

1. An electrical connector apparatus including a pair of cooperating connectors comprising:
  - one of said connectors having a cam groove and a coupling lever pivotally attached thereto, said coupling lever having an operation portion provided with a locking engagement portion extending therefrom,



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the other f said connectors having a driving pin advance-  
able into said cam groove upon pivoting of said cou-  
pling lever, and a lock portion to lockingly engage said  
locking engagement portion when said connectors are  
completely interconnected by the operation of said 5  
coupling lever, and

a lock-guiding portion disposed on said one connector  
adjacent and laterally spaced from said locking engage-  
ment portion, said lock-guiding portion having a sur-  
face thereon positioned with respect to said locking 10  
engagement portion to slidably engage said lock por-  
tion prior to engagement of said locking engagement  
portion therewith to thereby align said locking engage-  
ment portion with said lock portion prior to commence-  
ment of interconnection of said connectors by pivoting 15  
of said coupling lever.

2. An electrical connector apparatus including a pair of  
cooperating connectors comprising:

one of said connectors having a cam groove and a  
coupling lever pivotally attached thereto, said coupling 20  
lever having an operation portion provided with a  
locking engagement portion,

the other of said connectors having a driving pin advance-  
able into said cam groove upon pivoting of said cou-  
pling lever, a lock portion to lockingly engage said 25  
locking engagement portion when said connectors are  
completely interconnected by operation of said cou-  
pling lever, and lock protecting surfaces disposed on  
opposite sides of said lock portion, and

a pair of mutually spaced, oppositely facing lock-guiding  
portions disposed on opposite sides of, and extending  
laterally of, said locking engagement portion, said  
lock-guiding portions each having a surface positioned  
with respect to said locking engagement portion to 35  
slidably engage said lock-protecting surfaces prior to  
engagement of said locking engagement portion with  
said lock portion and thereby align said locking  
engagement portion with said lock portion prior to  
commencement of interconnection of said connectors 40  
by pivoting of said coupling lever.

3. An electrical connector apparatus including a pair of  
cooperating connectors comprising:

one of said connectors having a cam groove, a lock  
portion and a coupling lever pivotally attached thereto, 45  
said coupling lever having an operation portion pro-  
vided with a locking engagement portion engageable  
with said lock portion and a pair of mutually spaced,  
oppositely facing lock-guiding portions positioned at  
respective sides of said locking engagement portion,

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the other f said connectors having a driving pin advance-  
able into said coupling lever upon pivoting of said  
coupling lever,

said lock-guiding portions having surfaces thereon  
adapted to slidably engage said lock portion and  
thereby align said locking engagement portion with  
said lock portion prior to commencement of intercon-  
nection of said connectors by pivoting of said coupling  
lever.

4. An electrical connector apparatus including a pair of  
cooperating connectors comprising:

one of said connectors having a cam groove, a lock  
portion, lock protecting walls disposed on opposite  
sides of said lock portion and a coupling lever pivotally  
attached thereto, said coupling lever having an opera-  
tion portion provided with a locking engagement por-  
tion engageable with said lock portion and a pair of  
mutually spaced, oppositely facing lock-guiding por-  
tions positioned at respective sides of said locking  
engagement portion,

the other of said connectors having a driving pin advance-  
able into said coupling lever upon pivoting of said  
coupling lever,

said lock-guiding portions having surfaces thereon  
adapted to slidably engage said lock-protecting walls  
and thereby align said locking engagement portion with  
said lock portion prior to commencement of intercon-  
nection of said connectors by pivoting of said coupling  
lever.

5. An electrical connector apparatus as claimed in any one  
of claims 2 to 4, wherein said pair of lock guiding portions  
are each provided with a tapered lock-guiding surface in  
opposition each to the other.

6. An electrical connector apparatus as claimed in claim  
5, wherein said each tapered surface of said lock-guiding  
portion is provided with a tapered abutting portion adjacent  
the leading end of said lock-guiding portion in the direction  
of pivoting rotation of said coupling lever when said con-  
nectors are being coupled.

7. An electrical connector apparatus as claimed in claim  
4, wherein said pair of lock-protecting walls are each  
provided with a tapered lock-guiding surface at an outside  
face of said lock-protecting wall.

8. An electrical connector apparatus as claimed in claim  
2, wherein said pair of lock-guiding portions are each  
provided with a tapered abutting face at an outside surface  
of said lock-guiding portion.

\* \* \* \* \*